Project Elaboration: Smart LPG Cylinder Level Monitor & Reorder Assistant

1. Introduction

Liquefied Petroleum Gas (LPG) cylinders are a primary source of cooking fuel for millions of households in Bangladesh, particularly in urban and semi-urban areas where piped natural gas is unavailable or unreliable. Despite its widespread use, a common and frustrating problem faced by users is the unexpected depletion of gas, often in the middle of cooking. This leads to immediate inconvenience, last-minute scrambles to find a replacement cylinder, and potential disruption to daily routines. The lack of an easy and accurate way to monitor gas levels means households are often caught off guard, highlighting a significant gap in convenience and efficiency for a critical household utility. This project aims to solve this everyday problem by providing a smart, proactive solution for LPG cylinder management.

2. The Problem

- **Unexpected Gas Depletion:** The most significant pain point is running out of gas without warning. This disrupts cooking, causes stress, and necessitates urgent trips to find a new cylinder.
- **Inaccurate Manual Checking:** Users often resort to crude methods like shaking the cylinder or lifting it to estimate gas levels, which are highly inaccurate and can be physically demanding.
- **Inefficient Reordering Process:** When gas runs out, the reordering process can be cumbersome, involving phone calls, waiting for delivery, or physically visiting a distributor, especially if it happens at odd hours.
- **Safety Concerns:** While not directly addressed by monitoring, an empty cylinder can sometimes lead to unsafe practices if users try to extract residual gas or connect/disconnect cylinders improperly under pressure.
- **Lack of Consumption Data:** Households have no clear understanding of their LPG consumption patterns, making budgeting and planning difficult.

3. The Proposed Solution

A **Smart LPG Cylinder Level Monitor & Reorder Assistant** comprising a compact electronic sensor unit attached to the LPG cylinder and a user-friendly mobile application.

3.1. Electronic Device (Sensor Unit)

- **Core Functionality:** To be attached to the LPG cylinder to continuously monitor its gas level and transmit this data wirelessly.
- **Components:**
  - **Microcontroller Unit (MCU):** A low-power MCU (e.g., ESP32-C3, ESP8266, or a low-power ARM Cortex-M series) to read sensor data, perform calculations, manage power, and handle wireless communication.
  - **Gas Level Sensor:**
    - **Weight Sensor (Load Cell):** The most accurate method. A load cell (or multiple load cells) placed under the cylinder, connected to an HX711 amplifier module, can precisely measure the weight of the cylinder. As gas is consumed, the weight decreases.
    - **(Alternative/Complementary): Ultrasonic Sensor:** Mounted on top of the cylinder, pointing downwards, to measure the liquid level of LPG inside. This can be less accurate due to varying gas properties and cylinder shapes but offers a non-contact solution.
  - **Wireless Communication Module:**
    - **Bluetooth Low Energy (BLE):** For short-range communication with a paired smartphone app. Ideal for low power consumption.
    - **(Optional):** Wi-Fi (if the MCU supports it) for direct connection to a home network, enabling remote alerts or data logging to a cloud service.
  - **Power Source:**
    - **Rechargeable Battery:** A long-lasting Lithium-ion or LiPo battery (e.g., 500-1000 mAh) optimized for months of operation on a single charge.
    - **USB Charging Port:** For convenient recharging.
  - **Enclosure:**
    - A robust, compact, and non-flammable enclosure designed to securely attach to the LPG cylinder (e.g., via a magnetic base or a strap).
    - Must be resistant to heat and minor impacts.

3.2. Software Components

- **Mobile Application (Android/iOS):**
    - **Device Pairing & Configuration:** Simple process to connect the sensor unit to the app via BLE or Wi-Fi.
    - **Real-time Gas Level Display:** Shows the current gas level as a percentage, estimated remaining cooking time, or number of days left based on historical consumption.
    - **Consumption Tracking:** Graphs and charts showing daily/weekly/monthly gas consumption patterns.
    - **Alerts & Notifications:** Customizable push notifications for:
        - Low gas level (e.g., below 20% or 10%).
        - Estimated

estimated days remaining. * Battery low alerts for the sensor unit. * **Reorder Assistant:** * **Local Distributor Database:** A curated list of local LPG distributors with their contact information (phone numbers, WhatsApp, or even direct ordering links). * **One-Click Reorder:** Facilitates placing an order directly from the app (e.g., by initiating a call, opening a messaging app with a pre-filled message, or linking to an online order form). * **Delivery Tracking (Optional):** If integrated with specific distributors, could show delivery status. * **Settings:** Allow users to set custom alert thresholds, cylinder capacity, and preferred distributors. * **Cloud Backend (Optional, for enhanced features):** * **Data Storage:** Secure storage of anonymized gas consumption data. * **Consumption Analytics:** Aggregated data could help distributors optimize their logistics. * **Firmware Over-The-Air (FOTA) Updates:** For improving device functionality or fixing bugs remotely.

3.3. Conceptual Prototype Description

Imagine a small, sleek, black or grey puck-shaped device, roughly 5-7 cm in diameter and 2-3 cm thick. This device would be designed to sit discreetly under the LPG cylinder, or attach magnetically to its base. The load cell sensors would be integrated into its base, ensuring stable and accurate weight measurement. It would have no screen, relying entirely on the mobile app for user interaction. A single LED might indicate power status or successful connection. The device would be robust, designed to withstand the weight of a full cylinder and the typical kitchen environment. Charging would be simple, perhaps via a standard USB-C port on its side.

3.4. How it Solves the Problem

- **Eliminates Unexpected Outages:** Provides proactive alerts, allowing users to reorder well before the gas runs out.

- **Convenience:** Automates gas level monitoring, removing the need for manual checks.
- **Efficiency:** The reorder assistant streamlines the process of getting a new cylinder.
- **Cost Savings:** By understanding consumption patterns, users can better budget for LPG expenses.
- **Reduced Stress:** Removes the frustration and urgency associated with unexpected gas depletion.

This system offers a simple, yet highly impactful solution to a common household problem, significantly improving the daily lives of LPG users in Bangladesh.

Regarding Load Shedding Data for Project 2 (Localized Power Outage Prediction & Notification System):

Obtaining real-time, granular load shedding data for predictive analytics is challenging because official, publicly accessible APIs or centralized databases with such detailed information are generally not available in Bangladesh. Power distribution companies (like DPDC, DESCO, BPDB, REB) often publish daily or hourly load shedding schedules, but these are typically broad estimates and can change frequently due to unforeseen circumstances (e.g., generation shortfalls, transmission issues, local faults). They are usually published on their respective websites or social media pages.

Where to look for existing data (if any):

- **Official Distribution Company Websites:** Check the websites of Bangladesh Power Development Board (BPDB), Dhaka Power Distribution Company (DPDC), Dhaka Electric Supply Company Limited (DESCO), Rural Electrification Board (REB), and other regional distribution companies. They sometimes post daily schedules or notices.
- **News Media & Social Media:** Local news outlets and social media groups often share updates on load shedding, but this is reactive and not suitable for predictive modeling.
- **Community-Sourced Apps (if any exist):** There might be community-driven efforts or third-party apps that try to crowdsource load shedding information, but their reliability and coverage can vary.

The Challenge for Predictive Analytics:

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The core challenge for the **Localized Power Outage Prediction & Notification System** is the lack of a centralized, real-time, and granular data feed from the power grid. To

overcome this, the proposed solution relies on a **decentralized, crowd-sourced approach**:

- **Data Collection through the Devices Themselves:** The electronic devices deployed in homes would be the primary data source. When a device detects a power outage, it would timestamp this event and attempt to send it to the central server (e.g., via a low-power cellular module or LoRaWAN if a gateway is nearby). Similarly, when power returns, it would log that event.
- **Aggregated Local Data:** The software platform would aggregate these power status reports from hundreds or thousands of devices in a specific locality. By observing patterns (e.g., many devices in a specific area going offline simultaneously), the system can confirm an outage and its duration.
- **Predictive Modeling:** With enough historical data from these distributed sensors, machine learning models can be trained to identify patterns in outages (e.g., time of day, day of week, correlation with load shedding schedules, or even weather conditions). While official schedules might be a factor, the system would primarily learn from actual observed outages. The prediction would be based on these learned patterns and real-time data from other devices in the vicinity.

In summary, you won't find a single public API for real-time, granular load shedding data in Bangladesh that is suitable for direct predictive modeling. The strength of the proposed Project 2 lies in building its own distributed data collection network using the deployed electronic devices to generate the necessary data for prediction.